OUTBOARD MOTOR POSITION RESPONSIVE SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is continuation in part of application Serial No. 09/899,722, entitled "Outboard Motor Position Responsive System" filed 05 July 2001, the contents of which are incorporated herein by reference in their entirety and continued preservation of which is requested.

FIELD OF THE INVENTION

[0002] The present invention relates generally to powerboat motors and more particularly to alarms and ignition disabling systems for powerboats that are responsive to the absolute tilt position of an outboard motor.

BACKGROUND OF THE INVENTION

[0003] Systems that provide position sensing and response capability when a predetermined position of an object occurs have been disclosed for a variety of applications such as vehicle theft prevention, medical patient monitoring, earthquake detection, and to a limited extent, marine motors. Position sensing is generally accomplished in the related art with mercury switches, transducers and comparator circuits, variable resistance devices, infrared detectors, and other electrical devices. When a threshold position or condition has been registered by the position sensor, the sensor transmits a signal to a response device such as an alarm to warn an operator of an undesirable position of the object.

[0004] Devices and methods for position sensing, or tilt indication, of outboard motors are numerous and well known in the art. The devices generally provide an indication as to the absolute position or trim of the outboard motor through a visible analog gauge, hereinafter referred to as a trim position indicator, mounted on the instrument panel of the helm. A variety of electrical sensors are provided in the related art to detect the trim position and to subsequently communicate the absolute position of the outboard motor to the trim position indicator.

[0005] One such trim position sensor is disclosed in U.S. Patent No. 4,459,115 to Ballard, wherein an electrically conductive ball is employed that rides on individual electrical contacts to sense the position of the outboard motor. The position sensor of Ballard senses the position of the propeller with reference to the water line rather than relative to the transom. Additional trim position sensors are disclosed in U.S. Patent No. 4,005,674 to Davis, wherein the position of electrical contacts are varied with successive pivoting of the outboard motor, and also in U.S. Patent No. 3,641,965 to Schmiedel that employs a variable resistor with linear variable resistor cards to sense and indicate trim position. The related art trim position sensors, however, are limited to sensing the absolute position of the outboard motor and indicating such position on the trim position indicator.

[0006] The trim position sensors of the related art do not appear to communicate with the ignition system of a powerboat so as to produce an alarm or disabling signal if the outboard motor is in an undesirable tilt position. More specifically, the related art does not warn or prevent an operator from starting the

outboard motor if the outboard unit is improperly trimmed out of the water. For example, if the outboard motor is trimmed too high out of the water such that the water pump intake on the outdrive unit is out of the water, the water pump is deprived of necessary lubrication and can subsequently overheat and eventually fail. Moreover, water pump failure can lead to overheating and failure of the entire outboard motor. Additionally, the exhaust that exits from the exhaust port of the outdrive unit becomes extremely loud, thereby disturbing the operator, the passengers, and fellow boaters.

[0007] Accordingly, there remains a need in the art for a system that can warn and/or prevent a powerboat operator from starting the outboard motor if the outboard motor is improperly tilted out of the water. The device should also be inexpensive and capable of being easily retrofitted into existing powerboat systems.

SUMMARY OF THE INVENTION

[0008] In one form, the present invention provides an outboard motor position responsive device to inhibit or prevent a powerboat operator from engaging the ignition system while the outboard motor remains improperly tilted out of the water, i.e. beyond a maximum safe tilt position. The position responsive device generally comprises an outboard motor position sensor that is in communication with an existing ignition system of a powerboat. The outboard motor position sensor sends a signal to an alarm and/or an ignition disabling switch when the outboard motor is tilted up beyond the maximum safe tilt position. Accordingly, the alarm warns the operator of the undesirable tilt position and the ignition disabling switch

disengages the ignition system so that the outboard motor cannot be started. Further, either an alarm or ignition disabling may be employed, or both an alarm and ignition disabling may be employed by the outboard motor position responsive system of the present invention.

[0009] The outboard motor position sensor is preferably a voltage comparator circuit that is in communication with an existing trim position indicator of a powerboat. Existing trim gauges generally include a potentiometer mounted on the tilt axis of an outboard motor, thereby presenting a graphical reference of tilt position rather than specific voltage readings from the circuit. Similarly, the voltage comparator circuit of the present invention further comprises a potentiometer that is used to adjust a reference voltage that corresponds to the maximum safe tilt position of the outboard motor. When the reference voltage is approached, the voltage comparator circuit activates the alarm and/or the ignition disabling switch to warn the operator of the undesirable tilt position of the outboard motor.

[0010] In another form, the position responsive device further comprises an interval-on relay in communication with the outboard motor position sensor to activate the alarm or the ignition disabling switch for only a predetermined amount of time. Accordingly, the operator experiences the alarm and/or the ignition disabling switch as a warning only for a predetermined amount of time prior to starting the outboard engine. The operator may then engage the outboard motor and proceed at their own risk. The interval-on relay also prevents against wave-induced alarms or activation of the ignition disabling switch due to slight changes in

voltage from the oscillatory or "bouncing" action of the powerboat traversing through the water.

[0011] In other forms, the outboard motor position sensor may comprise other devices that sense the tilt position of the outboard motor. Such devices may include, for example, a mechanical limit switch, a proximity switch, a mercury switch, an optical switch, or a water sensing device, among others, as described in greater detail below.

[0012] In one form, the alarm is an audible electric buzzer that is easily heard by the powerboat operator. In other forms, the alarm may comprise, for example, a light such as an LED (light emitting diode) mounted to the helm, or a computerized voice warning, among others. In addition to disabling the ignition system, responsive devices that initiate automatic lowering of the outboard motor to a proper tilt position prior to engaging the ignition system are also provided.

[0013] In yet another form of the present invention, a microprocessor is in communication with the position sensor and further communicates with the alarm, the ignition system, and/or the responsive devices as disclosed herein. The microprocessor receives signals from the position sensor, processes the signal to generate specific outputs, and thus communicates with output devices such as the alarm or ignition system to warn against or prevent the outboard motor from extending beyond a maximum safe tilt position.

[0014] Communication amongst the outboard motor position sensor, the interval-on relay, the alarm, the ignition disabling switch, the microprocessor, and other system components may be accomplished by conventional hard wiring,

infrared (IR) signal transmission and reception, or radio frequency (RF) signal transmission and reception, among others. Further, signals may be superimposed over existing powerboat hard wiring to minimize the need for additional hard wire connections.

[0015] The present invention also provides a junction box that houses the components of the position responsive system, which is easily retrofittable with existing ignition systems of powerboats. The junction box is relatively small and further comprises adjustment screws that correspond with potentiometers that adjust the amount of time that the alarm and/or the ignition disabling switch remain activated and that adjust the reference voltage that corresponds with the maximum safe tilt position of the outboard motor.

[0016] Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating the preferred embodiment of the invention, are intended for purposes of illustration only and are not intended to limit the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

[0018] Figure 1 is a side view of a powerboat in the water with an outboard motor properly trimmed for ignition in accordance with the present invention;

[0019] Figure 2 is a side view of a powerboat in the water with an outboard motor tilted up beyond the maximum safe tilt position in accordance with the teachings of the present invention;

[0020] Figure 3 is a block diagram of the position responsive system in accordance with the present invention;

[0021] Figure 4 is a conceptual electrical schematic of the position responsive system in accordance with the present invention;

[0022] Figure 5 is an enlarged side view of the outboard motor of Figure 1 in accordance with the present invention;

[0023] Figure 6 is a top view of a junction box for integration of the position responsive system to an existing ignition system of a powerboat in accordance with the present invention; and

[0024] Figure 7 is a front view of the helm of a powerboat illustrating the related instrumentation in accordance with the present invention

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0025] The following description of the preferred embodiments is merely exemplary in nature and is in no way intended to limit the invention, its application, or uses.

[0026] Referring to Figures 1 and 2, a typical powerboat 10 generally comprises an outboard motor 12 that is capable of being tilted throughout a range, which includes the general up and down positions as shown. As illustrated in Figure 1, the outboard motor 12 is tilted down sufficiently such that a water pump intake 14

is submerged in the water and the outboard motor 12 is trimmed properly in the water for general operation. When the outboard motor 12 is tilted down to a proper tilt position, a water stream from a water pump outlet port 16 continuously flows from an outdrive unit 18, and the exhaust exits quietly from an exhaust port 20.

[0027] Referring to Figure 2, outboard motor 12 may also be tilted out of the water under various conditions such that water pump intake 14 is completely out of the water. When the outboard motor 12 is tilted out of the water as shown in Figure 2 while still running, the water stream from the water pump outlet port 16 stops and the exhaust becomes loud as it exits from the exhaust port 20 and the propeller 21. Furthermore, if an operator attempts to engage or start the ignition system when the outboard motor 12 is tilted up as shown in Figure 2, wherein the water pump intake 14 is out of the water, the water pump is deprived of necessary lubrication and may subsequently overheat and eventually fail. Moreover, water pump failure may lead to overheating and failure of the outboard motor 12. Additionally, the exhaust from the propeller 21 becomes disturbingly loud, especially to fellow boaters. The tilt position of outboard motor 12 as shown in Figure 2 is therefore an undesirable tilt position when the ignition system is engaged.

[0028] Accordingly, a position responsive system that warns against and/or prevents undesirable outboard motor tilt positions is illustrated in block diagram format and generally indicated by reference numeral 30 in Figure 3. The position responsive system 30 generally comprises an outboard motor position sensor 32 that senses the absolute position of the outboard motor, which is further in communication with the ignition system 34 of a powerboat. Generally, the outboard

motor position sensor 32 senses the absolute position of the outboard motor, i.e. whether the outboard motor 12 is properly trimmed as shown in Figure 1, or whether the outboard motor 12 is tilted up beyond a maximum safe tilt position as shown in Figure 2.

[0029] If a user attempts to engage the ignition system 34 when the outboard motor 12 is tilted up beyond a maximum safe tilt position, the outboard motor position sensor 32 activates an alarm 38 that warns the operator that the outboard motor 12 is improperly trimmed. Additionally, an ignition disabling switch 40 is similarly activated to prevent the operator from engaging the ignition system 34 when the outboard motor 12 is improperly trimmed. Furthermore, either or both the alarm 38 and the ignition disabling switch 40 may be employed in the position responsive system 30 in accordance with the present invention, depending on the specific operator requirements.

[0030] Optionally, a tilt circuit 41 may be activated such that the outboard motor 12 is automatically lowered to a properly trimmed position prior to engaging the ignition system 34. Therefore, the position responsive system 30 warns against and/or prevents engaging the ignition system 34 using one or a combination of the alarm 38, the ignition disabling switch, and the tilt circuit 41 when the outboard motor 12 is improperly trimmed.

[0031] As further shown, the position responsive system 30 also comprises an interval-on relay 42 that that limits the amount of time that the alarm 38 and/or the ignition disabling switch 40 are activated. Accordingly, the position responsive system 30 may be designed to warn the operator or prevent ignition of

the outboard motor 12 for a predetermined amount of time, and then allow the operator to start the outboard motor 12 at their own risk. As a result, the interval-on relay 42 bypasses the alarm 38 and/or the ignition disabling switch 40 after the predetermined amount of time for such an operating condition. Additionally, the interval-on relay 42 may be employed to prevent against wave-induced alarms and/or activation of the ignition disabling switch 40 with certain types of sensors used for the outboard motor position sensor 32 as described in greater detail below.

[0032] In an alternate form as shown by the dashed lines in Figure 3, a microprocessor 44 is used to process signals from the trim indicator 36 and to subsequently communicate with the alarm 38, the ignition disabling switch 40 and/or the tilt circuit 41. Alternately, the microprocessor 44 may also communicate with the outboard motor position sensor 32 as shown. In yet another form, the microprocessor 44 may communicate directly with the ignition system 34 from the outboard motor 12, wherein the appropriate circuits are contained within the microprocessor 44 and a voltage input is provided to the microprocessor 44 from the outboard motor 12 as an indication of trim position. As a result, the position responsive system 30 may be more easily altered for a variety of outboard motor types and is more conveniently packaged for ease of retrofit using the microprocessor 44. Accordingly, along with the microprocessor embodiment as described herein, the position responsive system 30 also includes memory, software, and an interface to the microprocessor 44, which are not described herein for purposes of clarity.

[0033] Preferably, the outboard motor position sensor 32 is a voltage comparator that is in communication with an existing trim position indicator 36 of a powerboat. Trim position indicator 36 is generally a voltage meter that detects the voltage at a potentiometer mounted on a tilt axis of the outboard motor 12. Further, the trim position indicator 36 displays a relative graphical reference of the tilt position of the outboard motor 12. Therefore, depending on the tilt position of the outboard motor 12, a different absolute voltage value is output to trim position indicator 36. More specifically, by providing communication between a voltage comparator and the trim position indicator 36, an absolute voltage value may be determined that corresponds with the maximum safe tilt position of the outboard motor 12. In principle, therefore, the voltage comparator compares the voltage detected by the trim position indicator 36 to a predetermined threshold value (reference voltage) that corresponds to the maximum safe tilt position of the outboard motor 12. Accordingly, the outboard motor position sensor 32 activates the alarm 38 and/or the ignition disabling switch 40 if the detected voltage approaches the predetermined threshold value.

[0034] In one form of the present invention, voltage values were recorded throughout the tilt range of a 90 horsepower outboard motor. The voltage values ranged linearly from approximately 11.91 volts in the fully tilted down position, to approximately 7.9 volts at the maximum safe tilt position, (wherein the water pump inlet 14 remained in the water), to approximately 6.9 volts in the fully tilted up position. Therefore, if the voltage value were to fall below the 7.9 volts, outboard motor position sensor 32 would activate the alarm 38 and/or the ignition disabling

switch 40 to warn the operator of an undesirable tilt position of the outboard motor 12 prior to engaging the ignition system 34. Accordingly, 7.9 volts was set as the reference voltage.

[0035] Referring to Figure 4, a conceptual electrical schematic for the position responsive system 30 is shown. The position responsive system 30 comprises a voltage comparator circuit 50 that is in communication with outboard motor position sensor 32, interval-on relay 42, the alarm 38, the ignition disabling switch 40, and an ignition switch 52. The ignition switch 52 is a part of the existing ignition system 34 of powerboats, and accordingly, the position responsive system 30 may be easily retrofitted therein for operation. Furthermore, the position responsive system 30 comprises a power source 54 and an electrical ground 56 to complete the electrical circuit as shown.

[0036] As shown, the voltage comparator circuit 50 further comprises a first potentiometer 58 and an existing trim gauge potentiometer 59. First potentiometer 58 is used to set the reference voltage in the voltage comparator circuit 50 that corresponds to the maximum safe tilt position of the outboard motor 12 as previously described. As further shown, the position responsive system 30 also comprises a second potentiometer 60 that is in communication with the interval-on relay 42. Generally, the second potentiometer 60 is used to set the predetermined amount of time that the alarm 38 and/or the ignition disabling switch 40 are activated.

[0037] The outboard motor position sensor 32, or the voltage comparator circuit 50 in the illustrated form, is normally open when the outboard

motor 12 is in the properly tilted position. When the ignition switch 52 is closed as the operator starts the outboard motor 12, electrical current bypasses the alarm 28 and passes through the ignition disabling switch 40, which is normally closed, to permit starting of the outboard motor 12. If, however, the outboard motor 12 is tilted at or beyond the maximum safe tilt position when the operator closes the ignition switch 52, the outboard motor position sensor 32 is closed, thereby activating the alarm 38 and/or the ignition disabling switch 40 as electrical current flows from the ignition switch 52 through the outboard motor position sensor 32 and to the alarm 38 and the ignition disabling switch 40. Accordingly, the alarm 38 and/or the ignition disabling switch 40 warn the operator that the outboard motor 12 is improperly tilted out of the water and should be tilted down into the water prior to engaging the ignition system 34.

[0038] As further shown, the interval-on relay 42 is preferably located between the outboard motor position sensor 32 and the alarm 38. Accordingly, the interval-on relay 42 is closed when the power source 54 is applied and is subsequently open after the predetermined amount of time as previously described. Therefore, if the outboard motor 12 is improperly tilted out of the water when the ignition switch 52 is closed, the outboard motor position sensor 32 is closed, thereby permitting current to flow through the interval-on relay 42 to the alarm 38 and/or the ignition disabling switch 40. After the predetermined amount of time, the interval-on relay 42 is open and the alarm 38 and/or the ignition disabling switch 40 are then bypassed.

[0039] In a preferred installation of the position responsive device 30 comprising a voltage comparator circuit 50, the voltage comparator circuit 50 is in communication with the trim position indicator 36, and the reference voltage is adjusted according to the following steps:

[0040] 1) The outboard motor 12 is tilted up to the maximum safe tilt position while the powerboat 10 is in the water. The maximum safe tilt position is easily determined by tilting the outboard motor 12 until the exhaust from the exhaust port 20 becomes loud or when the water stream from the water pump outlet port 16 stops as previously described.

[0041] 2) The outboard motor 12 is then tilted down to a position just below that which was determined in step number one.

[0042] 3) The first potentiometer 58 is then adjusted until the alarm 38 activates either on or off.

[0043] 4) The interval-on relay 42 is then adjusted for the desired amount of time that the alarm 38 and/or the ignition disabling switch 40 are to be activated.

[0044] As previously set forth, interval-on relay 42 is preferably employed to adjust the amount of time that the alarm 38 and/or the ignition disabling switch 40 are activated when an operator of the powerboat attempts to engage the ignition system 34 when the outboard engine 12 is tilted beyond the maximum safe tilt position. Additionally, the interval-on relay 42 is employed to prevent against false alarms or disabling of the ignition system 34 that may be induced by slight changes in voltage due to the oscillatory or "bouncing" action of the powerboat

traversing through the water. After the predetermined amount of time, the interval-on relay 42 is open and the alarm 38 and/or the ignition disabling switch 40 are bypassed. The predetermined amount of time in one form of the present invention is approximately five (5) seconds. After the predetermined amount of time, the interval-on relay 42 opens and is further reset in the closed position when the ignition switch 52 is opened.

[0045] In other forms, the voltage comparator circuit 50 may be replaced with another type of sensor such as a mechanical limit switch, a proximity switch, a mercury switch, or an optical switch that senses the position of outboard motor 12. As shown in Figure 5, a mechanical, proximity, mercury, or optical switch may be located on the outboard motor 12 and also on an outboard motor mount 60. When the outboard motor 12 is properly tilted as shown, the mechanical, proximity, mercury, or optical switch is open, thereby bypassing the alarm 38 and/or the ignition disabling switch 40. Conversely, when the outboard motor 12 is tilted up beyond the maximum safe tilt position, the mechanical, proximity, mercury, or optical switch is closed, thereby activating the alarm 38 and/or the ignition disabling switch 40.

[0046] In yet another form, the voltage comparator circuit 50 is replaced with a water detector 62 as further shown. The water detector 62 detects the presence of water and therefore senses the maximum safe tilt position of outboard motor 12 according to the position of the water detector 62 on the outdrive unit 18. If no water is detected, the water detector 62 senses the maximum safe tilt position of the outboard motor 12 and activates the alarm 38 and/or the ignition

disabling switch 40 accordingly. Conversely, if water is detected, the water detector 62 senses the properly tilted position of the outboard motor 12 and bypasses the alarm 38 and/or the ignition disabling switch 40. Additionally, the interval-on relay 42 may be employed to prevent against wave-induced alarms and/or activation of the ignition disabling switch 40 with the water detector since the outboard motor 12 is prone to oscillate or bounce as the powerboat traverses and impinges upon waves in the water. The oscillations or bouncing may intermittently expose the water detector 62 to air and water, thereby creating wave-induced alarms and/or activation of the ignition disabling switch 40.

[0047] In another form of the present invention, the output of the alarm 38 activates a tilt circuit 41 to automatically lower and properly tilt the outboard motor 12 when a position above the maximum safe tilt position is detected. Generally, tilt circuits are provided on most powerboats that raise the outboard motor 12, which are in electrical communication with existing power trim devices. Therefore, the position responsive system 30 may further be easily retrofitted with the electronic circuitry of existing outboard motor equipment.

[0048] Referring now to Figure 6, a junction box 70 is shown that houses components of the position responsive system 30 and is easily retrofittable with existing ignition systems of powerboats and. In one form, the junction box 70 is approximately 3" x 4" x 2" in size. The junction box 70 comprises two wires 72 that connect to the outboard motor position sensor 32, two wires 73 that connect to the ignition disabling switch 40, a fused wire 74 that connects to the ignition switch 34, an optional wire 75 that connects to the tilt circuit 41 to automatically lower and

properly tilt the outboard motor 12, and a wire 76 that connects to the electrical ground 56. The junction box 70 further comprises a first adjustment screw 78 that is used to adjust the first potentiometer 58 to set the reference voltage for the maximum safe tilt position of the outboard motor 12. Additionally, a second adjustment screw 80 is provided that is used to adjust the second potentiometer 60 that sets the predetermined amount of time of interval-on relay 42 and hence the amount of time that the alarm 38 and/or the ignition disabling switch 40 are activated.

[0049] The locations of various output devices of the present invention are illustrated in Figure 7 on an instrument panel 90 of a helm 92. The output devices in one form comprise an LED alarm 94 and an audible alarm 96. Other devices that are shown for a supplemental understanding of the present invention comprise an ignition switch 98, a trim position indicator 100, a throttle 102, and a power trim 104. The output devices are shown in only few of many positions and configurations that may be possible depending upon the design characteristics of the helm 92 and the instrument panel 90.

[0050] Although the components of the present invention are in communication via conventional hard-wiring as described herein, other methods commonly known in the art such as infrared (IR) signal transmission and reception, or radio frequency (RF) signal transmission and reception, may also be used while remaining within the scope of the present invention. Additionally, signals may be superimposed over existing powerboat hard wiring to minimize the need for additional hard wire connections.

[0051] The description of the invention is merely exemplary in nature and, thus, variations that do not depart from the gist of the invention are intended to be within the scope of the invention. Such variations are not to be regarded as a departure from the spirit and scope of the invention.